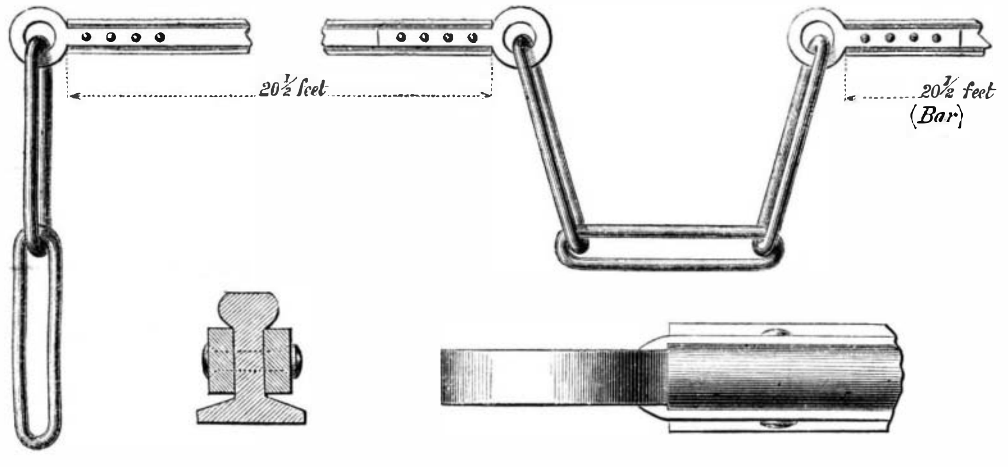
OBSTRUCTIONS OF CHARLESTON HARBOR.

We take pleasure in presenting accurate diagrams of the famous obstructions in Charleston harbor, by which our fleet was prevented from advancing up to the city. The principal reliance was upon the buoys attached to the bars of T-iron; if these had been once destroyed the whole thing would have gone to the bottom. We have no doubt but that if the same spirit had been displayed before Charleston as Colonel Bissel evinced in cutting the canal through the main land near Island No. 10, the obstructions could have been removed as easily as any other. "All things are possible to him who wills." The official report says:—"The obstructions consist of two bars of T-iron, 20½ feet long, to the ends of which strong eyes are fastened to receive three connecting links of iron, 33½ inches long and 2 inches in diameter; the whole weighing 1,500 lbs. They were doubtless supported by logs throughout their entire length, or by buoys at each end, forming a very formidable barrier."



POLYTECHNIC ASSOCIATION OF THE AMERICAN INSTITUTE.

The Association held its regular weekly meeting on Thursday evening, March 24th; the President, S. D. Tillman, Esq., in the chair. After the President's usual summary of scientific and industrial news of the week, Dr. Stevens, having just returned from an examination of the district, was invited to give a description of the

CUMBERLAND COAL DEPOSIT.

Dr. Stevens—"Mr. Chairman, I have made a sketch on the blackboard here, of the rocks as we find them deposited in a line extending from the north-east corner of this State south-westwardly 300 miles into Pennsylvania. While the surface of the ground rises gradually, as indicated by this upper line, the rocks still lie in their original horizontal position, so that in going from the north-east to the south-west we meet first with the lowest rocks, and then in succession with those which are lying above. We pass over the sloping edges, first of the Lower Silurian, then of the Upper Silurian, then of the Devonian, and lastly of the Carboniferous. These beds are lying almost exactly horizontal, with a very slight inclination toward the south-west, and with only one break or fault in their whole extent. In the Cumberland coal district of Maryland we find these same rocks lying one upon another in the same relative pasition, but folded in great plications, and affording the most impressive evidence of the tremendous forces by which they have been heaved up and bent from the horizontal strata in which they were originally formed on the bottom of the sea. These lines represent the formation of the mountain when it was first pushed up—the upper stratum or Carboniferous being upon the outside, and the lower strata being rounded up in corresponding form below. But to represent the present condition of the mountain we must not only wipe off its top, but we must scoop out a great valley in its center. We now find the lower Silurian rock paving the bed of the valley, and the Upper Silurian, the Devonian and the Carboniferous cropping out on each side of the valley above, the several formations being of just about the same thickness on each side of the valley, and lying one upon another in the same relative position. This valley is five miles in width and 1,800 feet in depth. There is no reasonable explanation of the mode in which this great mass of rock has been carried away except the wearing of water. When the mountain was thrown up, cracks were doubtless formed along its summit; into these the rain fell, streams were formed, and thus the heart of the mountain was worn away. The debris from those denudations was carried by the rivers to the sea, and is now found spread along the shore, extending inland in some places many miles, and lining the banks of the rivers from their mouths upward to distances proportioned to the size of the streams, being in the case of the Mississippi 600 miles."

The remainder of the evening was spent in listening to a paper by Mr. Heaton, which contained no new statement of facts.

HOW SUGAR IS MADE FROM THE CANE.

A correspondent of the Boston *Trumpet and Freeman*, writing from the Island of Mauritius, describes the process of making sugar in a clear and concise manner. The narration will be found worth reading:—

"My readers doubtless know that the great staple of Mauritius is sugar. While all the productions of the tropics may be grown here, and nearly all are grown here to some extent, yet the great, the almost sole reliance is sugar. The crop of 1862–3—the crop year terminates on the last day of July—amounted to about one hundred and sixty thousand tuns, or upwards of three hundred millions of pounds. Some idea of this enormous quantity may be gained by considering that it is sufficient to load three hundred and twenty vessels of five hundred tuns each. The foregoing statement will also furnish as good an idea as can easily be got of the amazing fertility of the island. For be it remembered that this little-dot upon the map of the globe is only about thirty-five miles long, and less than that in breadth, being a little more than one hundred and three miles in circumference. On the estate visited there were about one hundred and fifty laborers, mostly Indians, though with a few negroes. As we approached the building, we saw men busily occupied in bringing forward the canes. These are cut and stripped of all their leaves in the fields where they are grown, and only the thick, heavy, juicy stalk brought to the sugar-house. The machinery here is all propelled by steam. We entered first the grinding-room. Two men were engaged in bringing in the canes, and placing them on the apron of the mill. Two others, one standing upon each side of the apron, fed the mill; while a fifth stood behind the mill to receive and dispose of the crushed canes after they had passed through the mill. The mill consisted mainly of three solid iron rollers, about twelve or fifteen inches in diameter, with shafts running out on one side and connecting with the propelling power. Two of these rollers were at the bottom, and the third directly over neither, but over the line which separated the two lower ones, and in such relations to them that the canes, in passing between them, did, in effect, pass between two pairs of rollers, or were subjected to two grindings. These were so geared that they could be made to press more heavily or lightly upon each other, at the option of the overseer. Once passing the canes through was sufficient thoroughly to expel the juice. As it was expressed it fell into a shallow tank below, from which it was conducted off through an open trough into another apartment. Entering this other apartment, we found the cane-juice pouring through a coarse seive into a large tank, where it was allowed to remain for a little lime, until the grosser impurities had risen to the surface, when the purer liquid below was drawn off through iron pipes into immense kettles or pans, where it was reduced to the proper consistency by boiling, and where men were constantly engaged in skimming off the feculence which the violent agitation threw to the surface. From these kettles or pans the sirup was conducted into what are called 'wetzells'—a machine named from the inventor—in which the sirup is 'cooked.' It is maintained here at boiling heat, and is kept in constant motion to prevent its burning. This machine consists mainly of two parts—one, a half cylinder about ten feet long, placed horizontally, which contains the sirup, and under which, I believe, is a chamber filled with steam; and the other a skeleton cylinder, somewhat smaller in circumference than the aforesaid half cylinder, which revolves within the latter, and the frame, or bones of which, so to speak, is composed of iron tubes also filled with steam. This skeleton cylinder, revolving in the half cylinder, or trough, not unlike the manner of some patent Yankee churns, though not so rapidly as to throw over any of the contents, keeps the sirup in constant motion and prevents its burning. When the 'cooking' is completed, the contents of the 'wetzells' are drained off into large and shallow vats, where the sirup is cooled, and the sugar crystallized. Hence it is passed through a crushing mill, where whatever large or small lumps may have formed are reduced to powder. Then the sugar is put into the 'turbines,' where the sirup still remaining in it is expelled, and the sugar dried sufficiently for bagging or barrelling. These 'turbines' consist of two upright iron cylinders, one within the other. The outer is stationary, and strongly secured in its place. Between the two there is a space perhaps an inch wide. The inner cylinder revolves within the other. Its rim is perforated with small holes; the bottom of it is tight, and the top is open. Into this open place is put the sugar, wet and black with molasses; in from five to eight minutes it is taken out comparatively dry and light colored. The great and sudden change is effected by the rapid movement of the inner cylinder, it revolving no less than twelve hundred times per minute. The sugar is taken hence to the bagging-room, where it is prepared for the market.

"As above described the process of sugar-making seems quite summary; and indeed it is. The cane-juice expressed each day is manufactured into sugar before the work ceases at night: the grinding commencing and ending a few hours earlier than the processes. Unlike the sugar-growers in Cuba, the planters here do not run their mills night and day the season through, but commence anew with every morning. That to do so is much less exhausting to the men may readily be supposed; while a better quality of sugar is thought to be obtained by the closer attention to the work thus secured."

Testing Armor-plates at Portsmouth.

Some testing of armor-plates has taken place at Portsmouth, England. The plates were of 5½ inches in thickness, 15 feet 6 inches in length, and 3 feet 3 inches in width. One from Messrs. John Brown and Co., of Sheffield, was for the iron frigate *Agincourt*, and the other for the iron frigate *Northumberland*. Both were tested in the first place with cast-iron shot from the 68-pounder gun in the ordinary way. Both passed through the ordeal satisfactorily, although tried severely by clusters of shot impacts and edge blows. The maximum depth of the indents was 2 inches and the minimum 1 1-16 inches. On Brown and Co's plate in its upper right centre, four shots struck in a semicular line, that measured but 32in. through the greatest extent of the curve. Throughout this space there was only one small surface crack. On the left lower corner of this plate five shots struck, impinging on each circumference. Two of them were only half on the plate's edge. The plate exhibited wonderful tenacity and solidity, without the slightest appearance of brittleness. The Millwall plate was also struck in several places on its right lower edge, but without penetration being effected, although a small semicircular piece, 24in. in length by 10in. in width, was broken out through half the plate's thickness. The laminæ were opened on the plate's edge in the vicinity of the places struck. The plates were of undoubted excellence both in the quality of the metal and in their manufacture. Messrs. Brown's plate was then selected for firing against, with improved cast iron spherical (crucible) shot from the Elswick 100-pounder smoothbore gun, (diameter of bore 9in. and weight 120 cwt. 2qrs.,) with a charge of 25lbs. of powder. Three shots were fired. No. 1 struck the lower edge and touched a bolt. It produced an indent of 4in. at its greatest depth, with a diameter of 9½in., and with only a surface crack round the indent. No. 2 struck just over the lower edge, producing an indent of 10in. in diameter and a greatest depth of 3 8-10in. with a slight surface crack in the indent. Both these shots were destroyed in the ordinary manner of casting projectiles. No. 3 shot struck fairly on the plate, and part of it remained fastened in the plate's outer surface. It will be seen that the damage inflicted by these improved cast-iron shot was hardly commensurate with their increased weight and the extra 9lbs. of powder charge as compared with the 68-pounder gun. The Millwall plate had next three steel shot sent against it from the same Elswick gun, with a similar charge of 25lbs. of powder, the result being—No. 1 shot struck about 4in. below the upper edge of the plate, a distance away from any damaged part, and breaking right through, buried itself, and the broken parts of the plate in the ship's side 12in. beyond the plates inner surface. No. 2 shot struck the plate in a central and undamaged part, went clear through and buried itself with the broken fragments in the side of the ship, the outer surface of the shot being 3in. below the plate's outer surface. No. 3, the last shot, also struck the plate in a central and undamaged part, and about 2ft. aside of the last shot. It cuts its way in with 9½in. diameter, about one-third of the plate thickness, and then carried everything before it on the lower deck of the target ship. The shot in passing through the broken pieces of plate increased the diameter of the hole it made on entering the plate from 9½in. to 3ft. at the other end. It passed entirely through one side of the ship, and struck against the opposite side. The shot entering the plate by a hole 9½in. diameter passed into the ship by a hole 3ft. in diameter, tearing five planks away from the inside, and covering both sides of the deck for some distance round with broken pieces of wood and iron. One piece of plate, measuring 17in. by 14in. was picked up on the ship's deck, 15ft. from the side of the ship where it had entered with the shot. The shot itself was found on the opposite side of the ship's deck, and was but very little changed in form.

Estimating the Weight of Cattle by Measurement.

The *Canada Farmer* in reply to a correspondent, says :—

Many experiments have been made by graziers and salesmen to ascertain the net weight of cattle by measurement, and a number of rules and tables have been formed from the results obtained. None, however, can be regarded as absolutely correct. With the most accurate measuring is required a practical acquaintance with the points and forms of animals, and allowance must be made according to age, size, breed, mode and length of time of fattening, &c. ; conditions which require a practical eye and lengthened experience to correctly appreciate. We have found the following method to lead generally to trustworthy results :—

Measure carefully with a tape line from the top of the shoulder to where the tail is attached to the back; this will give the length. For the girth, measure immediately behind the shoulder and fore legs. Multiply half the girth by itself in feet, and the sum by the length in feet, and the product will give the nett weight in stones of 8 lbs. each. For example, with an ox or cow 5 feet in length and 7 feet in girth, the calculation will be as follows:—

Multiply half the girth by itself in feet	3.5
	3.5
	12.25
Multiply by the length in feet	5
Weight in stones	61.25

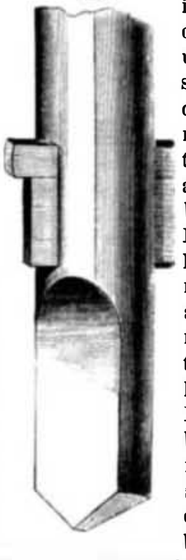
THE DRILL AND ITS OFFICE.

[Continued from page 213.]

In our last article on this subject we considered counter-borers or composite drills, and we will now allude to the same class on different plans.

There is still another kind of drill for peculiar work which is employed by some machinists, though for our own part we see no special virtue in it, for it is troublesome to use and to make, and very liable to break. It is called the tit or center drill and here is an engraving of it. The center marked out by the punch is of course the point where the tit is inserted on the work. This tit is the cause of all the trouble with the tool; it must be filed up in the vice, it tries the tool-dresser's patience to harden it, for the small quantity of metal in it compared to the heavier parts in proximity causes it to get hot in the fire more speedily and also to cool quicker, so that while the cutting edges are of the right temper the tit is soft or hard as the case may be; for all ordinary purposes the common flat drill is far superior.

Another kind of drill is illustrated below; it is a turned drill and will go, if it runs true in the machine, as straight as a die in the work. These two figures are side and end views; the tool is simply forged and then turned up in the lathe afterward, and it is much used for drilling holes in the tube sheets of surface condensers. Composite drills are those made by combining cutters with drills in such a manner that while the hole is being drilled or just after the operation, it is also countersunk on top, or counterbored to a certain depth; and this without removing the drill from the hole, thus saving a great deal of time. When the tube sheets of surface condensers are drilled, such tools do good service, for the vast number of holes requires some such method to render it economical as well as to expedite the job. The plans for a drill capable of being used for such work are given below. The drill is simply a turned steel bar flattened on the end for but a short distance; as the plate to be drilled is not thick it does not require to be long but should be made as short as possible. There is a key-way or slot, in the shank in which the cutters are set, and secured by a small key at the back. The shape of the cutter fitted in the key-way, of course varies with the work to be done, and the corners may be rounded off to make a round-bottomed hole, or made to conform to any pattern desired, and the key may be made short so that the cutter can go clear through. Drills of this kind are also extremely useful for counter-boring in lathes; a dog may be slipped over the round shank and screwed up while the center in the drill shank is received by the dead center of the lathe. It is much more economical to use a tool of this kind where the circumstances admit of it, than to bother with boring tools of the usual pattern. It is in the minor details of this kind that workshop economy may be practiced to advantage, and there is nothing that calls more for the exercise of ingenuity than the simple matter of drilling holes speedily and accurately. In every instance it must be borne in mind that it is of the utmost consequence that the drill should run *true* on its end. Without this the finest temper and the best shape are of no value, and it is impossible to do good work where the point of the drill describes a circle of greater or less diameter.



From specific designs of drills let us depart at present and turn our attention to the other end of the same tool, where we shall find something worthy of attention. We might fill page after page with drills of peculiar shapes; those with and without lips, those with lips or cutting edges curved so that a section would be like this, ∞ ; others with round corners, &c., but as the main principles of drills have already been given it is not necessary that we should follow out every design, as it would interfere with more important matters. Let us look at the drill shank. It is a common and a favorite expression with many that the minor trials of life cause more sharp annoyance and vexation than severe visitations. Be this as it may, it is very certain that the simple matter of the formation of the drill shank has caused more profanity, delay, and actual pecuniary loss than any similar part of any other tool. The shank is in general made square and taper as in this engraving, and the adherence to this form, the most injudicious and expensive that could be devised, is remarkable. Drilling machines upon new plans are made every day, and are fitted with some ingenious device for expediting the work, but for some inexplicable reason the spindle is squared out, duly tapered, and with—the hight of absurdity—a set screw in addition. It is among the impossibilities of mechanical practice that a square-shanked drill should ever run true by any possibility except one involving great expenditure of time and consequently money. It must be acknowledged by every unprejudiced person that the true shape for a drill shank is round and parallel, not tapered like a lathe center. With this form the drill in all cases will run much truer than with any other shape; not only is this assertion correct, but the labor or cost of making the drill shank in this form is not to be mentioned with a square or taper one. The round hole in the spindle of the machine is capable of being wholly finished in the lathe, so that when it leaves that tool it is completed and does not require to be chipped out or even filed. Squaring the hole makes it untrue with the center of the spindle, even when great care is used, and the drills themselves have to be forged exactly alike or else they will not fit. In a shop where there are thirty or forty drilling machines and a thousand drills there are scarcely any two alike, and when a square-shanked drill is put into a squared spindle, the point describes a circle of no small magnitude. Then comes the corrector of this evil—bang goes the hammer—the drill falls out, and a piece of emery cloth is wrapped about it because it is rough and holds better; the tool is replaced and the same process goes on again and again, sometimes varied by breaking the drill short off at the shank, at others only succeeding after much time and trouble in making the drill run true. Each time it is dressed the drill is altered so that it is no exaggeration to say that it never runs twice alike. The set screw is a nuisance, it is of no use at all; when set up to its place it strikes one-sided, and instead of securing the drill actually pushes it out. How easy it would be to avoid all this complexity by making the shank in this form, or forging the drill of round steel! There are many advantages in this, although round steel is not uniformly of as good a quality as square steel. The most marked advantages are lessened first cost of construction, greater efficiency of the tool itself and less time expended in straightening and setting the drill; a standard size for all drills so that each one will fit every machine in the shop, and less work in making the drill machine itself. The taper round shank drill is not so good for these reasons: It costs more than either of the others, it is troublesome to get out of the machine, for a key has to be driven in at the end, which often gets lost. The hammer is used to loosen the drill by men too lazy to take the key when it is not lost; the taper gets bruised by the blacksmith in dressing the drill; when the drill has to be upset, as it does at times, the